⑫ **EUROPEAN PATENT APPLICATION**

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�54 Sinusoidally distributed winding method suitable for a detector winding.

�57 A sinusoidally distributed winding method suited for a detector winding comprises the steps of connecting serially winding groups (x) wound sequentially at one-slot intervals to form one phase shunt winding group (y), and constructing a n-phase shunt winding group (z) using one phase shunt winding groups (y) of n in number. Automatic winding can be performed based on the winding group wound sequentially at one-slot pitch intervals.

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FIG. 15
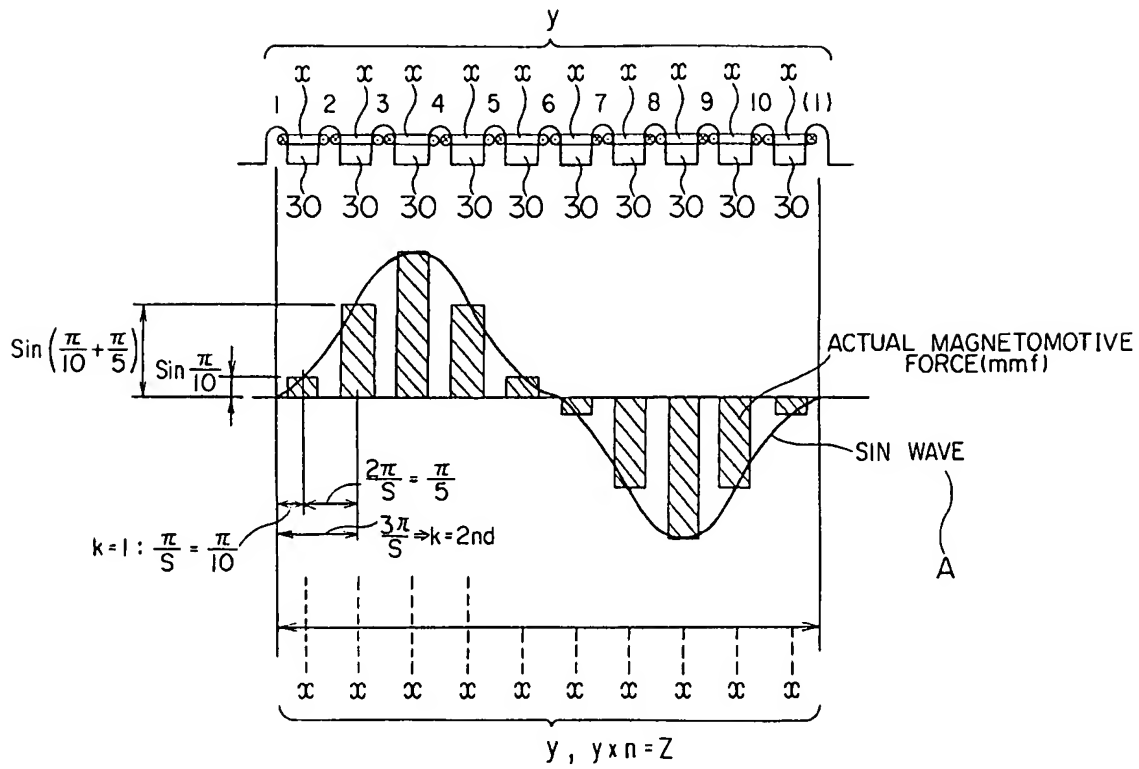
1) Field of the Invention

The present invention relates to a sinusoidally distributed winding method suitable for a detector winding, and more particularly to a novel improvement wherein one-phase shunt-windings group is formed by connecting serially winding groups which are wound sequentially at one-slot pitch intervals and a 2P polar and n-phase sinusoidally distributed magnetic flux is obtained by the shunt-winding of one-phase winding group by n-phases, whereby a winding can be performed using an automatic winding machine.

2) Description of the Related Art:

Conventionally, the methods shown in Figs. 1 through 5 has been generally used as a sinusoidally distributed winding method adapted for sensor windings such as resolvers, synchros, and the like. That is, in Figs, 3 and 4, numeral 20 represents a stator formed in cylindrical shape as a whole. A plurality of slots 30 are formed inside the stator 20. In the slot Nos. 1 to 16, one-phase first stator windings 21, each formed previously in a ring shape, are arranged between the slots 4 and 6, 3 and 7, 2 and 8, 1 and 9, 1 and 9, 16 and 10, 15 and 11, and 14 and 12. A rotor receiving hole 22 is formed inside each of the slots 30 by spreading in the direction of the arrow B after mounting the first stator winding 2.

Among the slots 30, second stator windings, each formed in a ring shape, are arranged between the slots Nos. 2 and 16, 3 and 15, 4 and 14, 5 and 13, 5 and 13, 6 and 12, 7 and 11, and 8 and 10 so as to be perpendicular to the first stator winding 21. As shown in Fig. 3, the stator windings 21 and 23 are arranged respecrively in the slots 30 of a stator 20 by spreading in the direction of the arrow A after arranging the second stator winding 23. A rotor having a rotor winding (not shown) is arranged rotatably within the rotor receiving hole 22. The stator windings 21 and 23, as shown in Figs. 1 and 2, are arranged in such a manner for Resolver shown in Fig. 9 that the winding at each slot 30 produces a sine or cosine phase (2-phase) sinusoidally distributed magnetic flux.

Therefore, for example, when a fixed ac voltage is applied to the rotor winding in the above-mentioned state, electromagnetic induction produces a voltage due to an interlinkage magnetic flux between the stator windings 21 and 23, thus producing a rotation detection signal.

However, the conventional sinusoidally distributed winding method for a detector winding has the following disadvantages.

In the prior art method, windings in ring shape are inserted previously within each of the slots by jumping over the adjoining slots and then the windings are spread to arrange them on respect slots. Therefore it is impossible to carry out winding by means of an automatic wiring machine. Since all winding procedure is performed manually, it has been impossible to achieve improved production efficiency and cost reduction.

The present invention is made to overcome the above mentioned problems. Particularly, an object of the present invention is to provide a method of forming a sinusoidally distributed winding for a detector where one-phase winding group is constructed by connecting serially winding groups which are wound sequentially at one-slot pitch intervals whereby a 2P polar and n-phase sinusoidally magnetic flux is obtained by winding groups to n-phase and can be formed using an automatic winding machine.

According to the present invention, in a sinusoidally distributed winding method for a detector winding where n-phase winding groups are wound on a ring core which has a given number (S) of tooth portions and slots on its inner diameter side so that one-phase winding group of said n-phase winding groups produces a 2P polar and sinusoidally distributed magnetic flux distribution, the improvement comprising the steps of connecting directly winding groups of the number (S) corresponding to that of the slots (S) to construct the one phase winding groups, the winding groups being wound at one-slot pitch intervals, and using a plurality of the one-phase winding groups to construct the n phase winding groups, whereby a 2P polar and n-phase sinusoidally distributed magnetic flux is provided.

In detail, the number of winding of each of slots of one phase winding group is obtained from the formula (1).

$$N_{k1} = \frac{W\sin\left[2\pi\, P/S\left\{(k-1)+\frac{1}{2}\right\}\right]}{\sum\limits_{i=1}^{s}\sin\left[2\pi\, P/S\left\{(i-1)+\frac{1}{2}\right\}\right]}$$

$$N_{k2} = \frac{W\sin\left[2\pi\, P/S\left\{(k-1)+\frac{1}{2}\right\}+\frac{2\pi}{n}\right]}{\sum\limits_{i=1}^{s}\sin\left[2\pi\, P/S\left\{(i-1)+\frac{1}{2}\right\}+\frac{2\pi}{n}\right]}$$

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$$N_{k(n)} = \frac{W\sin\left[2\pi\, P/S\left\{(k-1)+\frac{1}{2}\right\}+\frac{2\pi\,(n-1)}{n}\right]}{\sum\limits_{i=1}^{s}\sin\left[2\pi\, P/S\left\{(i-1)+\frac{1}{2}\right\}+\frac{2\pi\,(n-1)}{n}\right]}$$

Equation (1)

where

$N_{k(n)}$ is the number of turns of the winding portion at the k-th slot, or a given integer satisfying i = 1 to s in the (n)-th winding group in n-phase;

W is the total number of turns (the sum of windings would at each slot of i = 1 to s in one phase) ; and

S is the number of slots.

In detail, in the n-phase winding groups, a resolver is formed in the sine phase winding and the cosine phase winding which are arranged alternately in the inner side and the outer side of each of slots.

In more detail, the n-phase winding group is wound by way of a guide pin which is arranged at an outer position of each of slots in the ring core.

In still further detail, an insulating member with a guide pin is arranged at each of slots in the ring core, and the n-phase winding group is wound through the guide pin.

In the sinusoidally distributed winding method for a detector winding according to the present invention, S winding groups corresponding to a predetermined number S of slots are obtained by forming sequentially winding in the ring core at one-slot intervals, while an automatic winding can be carried out using a winding machine to form one-phase winding group by connecting serially each of the winding groups. An N-phase sinusoidally distributed magnetic flux can be obtained by winding one-phase winding group by n phases.

The above and other objects, features and advantages of the present invention will be apparent from the following description when is read in conjuncton with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a structural diagram showing a conventional winding method;
Fig. 2 is a structural diagram showing a conventional winding method;
Fig. 3 is a perspective view showing a conventional resolver;
Fig. 4 is a structural diagram showing a conventional winding; and
Fig. 5 is a structural diagram showing conventional windings and sine wave distribution.
Fig. 6 is a perspective view showing a ring core using a detector winding according to the present invention;
Fig. 7 is a structural diagram showing one or two phase winding;

Fig. 8 is a structural view showing a three- phase winding which is called synchro winding.

Fig. 9 is a structural diagram showing a 4 phase = irregular two-phase winding which is called resolver winding.

Fig. 10 is a structural diagram showing a n-phase winding;

Fig. 11 is a perspective view showing another embodiment of the winding shown in Fig; 6;

Fig. 12 is a disassembled perspective view showing another embodiment of the winding shown in Fig. 11;

Fig. 13 is a cross sectional view of a resolver;

Fig. 14 is a side view of a resolver;

Fig. 15 is a structural diagram showing one-phase winding group and sinusoidally distributed amplitude;

Fig. 16 is a structural diagram showing another embodiment of one phase shunt winding group and sinusoidally distributed amplitude;

Fig. 17 is a structural diagram showing a winding group in each of slots;

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to attached drawings, an explanation will be made in detail as for a preferred embodiment of a sinusoidally distributed winding method for a detector winding according to the present invention. The same or similar portions as those in prior art will be explained by denoting the same numerals. Figs. 6 through 17 show a sinusoidally distributed winding method adopted for a detector winding acording to the present invention.

Referring to Fig. 6, numeral 20 represents a ring core as a stator which has a given number S of slots 30 and teeth 31 opened inside the inner diameter and is formed by laminating a large number of core elements. In the one-phase winding group Z arranged in each of the slots 30, Fig. 7 shows two phase or one-phase winding, Fig. 8 shows 3-phase winding (synchro), Fig. 9 shows 4-phase winding (or irregular 2-phase resolver), and Fig. 10 shows n-phase winding.

In Fig. 11, guide pins 41 are planted at the outer positions of slots 30 in a ring core 20 and the n-phase winding group Z is wound via the guide pin 41.

In the method shown in Fig. 12, a pair of ring insulating members 43 and 43a which is formed integrally with a slit insulating portion 42 within each of the slots 30 are fitted on both ends of the ring core 20. The ring insulating members 43 and 43a has a slit insulating portion formed integrally with a guide pin. n-phase winding group Z is wound via the guide pin 41.

In Figs. 13 and 14, a stator is constructed using the above-mentioned ring core 20 and a rotor 44 is arranged rotatably within the rotor guide hole 22 which is formed in the center of the ring core 20. A resolver 55 comprises the ring core 20 and the rotor 44. The ring core 20 should be limited to a stator but may be applicable for the rotor.

Further, the sinusoidally distributed winding method for a detector winding according to the present invention will be explained below.

For example, as shown in Fig. 15, the ring core 20 has 10 slots 30 (or S = 10) and 10 teeth 31, and a 2P polar revolver with a single pole and P poles has one-phase shunt winding group y. In this case, the windings 40 are wound sequentially at one slot pitch intervals; S winding groups X (or S = 10) for each slot 30 are connected serially; one-phase shunt winding groups y is formed of the 10 winding groups x; and finally n-phase shunt winding group Z is formed by combining one phase shunt groups y of n in number.

Therefore, shown in Fig. 15, the n-phase shunt winding group Z produces, in the entire angle of 2π radian of the ring core 20, a pulse magnetomotive force (like a bar graph) to each of the winding groups x (with different winding number) in each slot 30. A sine wave magnetic flux A is formed by the envelope of magnetomotive forces.

In the case of 12 slots (or S = 12) as shown in Fig. 16, one phase shunt winding group y which is obtained by connecting serially 12 winding groups x is formed by utilizing the same winding method as the above-mentioned one. The magnetic flux distribution at the sine side and the cosine side can be obtained by using 1st-phase shunt winding group Z employing n 2nd-phase shunt winding groups.

One phase shunt winding group y is formed by connecting serially the winding groups x respectively. The n-phase shunt winding group Z which is formed by winding the one phase winding group y by n-phases is expressed by the following general formula (1).

$$N_{k1} = \frac{W \sin\left[2\pi \, P/S\left\{(k-1)+\frac{1}{2}\right\}\right]}{\sum_{t-1}^{s} \sin\left[2\pi \, P/S\left\{(i-1)+\frac{1}{2}\right\}\right]}$$

$$N_{k2} = \frac{W \sin\left[2\pi \, P/S\left\{(k-1)+\frac{1}{2}\right\}+\frac{2\pi}{n}\right]}{\sum_{t-1}^{s} \sin\left[2\pi \, P/S\left\{(i-1)+\frac{1}{2}\right\}+\frac{2\pi}{n}\right]}$$

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$$N_{k(n)} = \frac{W \sin\left[2\pi \, P/S\left\{(k-1)+\frac{1}{2}\right\}+\frac{2\pi\,(n-1)}{n}\right]}{\sum_{t-1}^{s} \sin\left[2\pi \, P/S\left\{(i-1)+\frac{1}{2}\right\}+\frac{2\pi\,(n-1)}{n}\right]}$$

Formula (1)

where

$N_{k(n)}$ is the number of turns of the winding portion at the k-th slot, or a given integer satisfying i = 1 through s, in the (n)-th winding group in the n-phase;

W is the total number of turns (the sum of windings wound at each slot of i = 1 through s in one phase); and

S is the number of slots.

Among the slots 30 being S n number, the k-th winding number from the first slot to the (S)th slot is shown and various formulas for Nk1 to Nk(n) are applied with respect to slots 30 in Figs. 15 and 16.

The formula (1) is a general one for n-phase winding, and, for example, should not be limited to a resolver. In the case of a resolver, when n = 4, an irregular 2-phase is provided.

$$N_{k1} = \frac{W \sin\left[2\pi \, P/S\left\{(k-1)+\frac{1}{2}\right\}\right]}{\sum_{t-1}^{s} \sin\left[2\pi \, P/S\left\{(i-1)+\frac{1}{2}\right\}\right]}$$

Formula (2)

(sine side)

A sine side (1st-phase) winding is shown and has coils of S in number.

$$N_{k2} = \frac{W \sin\left[2\pi \, P/S\left\{(k-1)+\frac{1}{2}\right\}+\frac{\pi}{2}\right]}{\sum_{t-1}^{s} \sin\left[2\pi \, P/S\left\{(i-1)+\frac{1}{2}\right\}+\frac{\pi}{2}\right]}$$

Formula (3)

A cosine side (2nd-phase) is shown and has coils of S in number.

That is, one-phase shunt winding group y being 1st-phase winding at the sine side is formed in accordance with the formula (2). One-phase shunt winding group y being 2nd-phase winding at the cosine side is fromed in accordance with the formula (3). The n-phase shunt winding group Z comprises windings x and y. In this case, an explanation is omitted because the third-phase winding is the same as the first one while the fourth-phase winding is the same as the second one.

The winding group x (the number of the slots 30 are S) is represented by the formula (4) by resolving 1st-phase shunt winding at the sine side expressed by the formula (2) into slots 30.

$$N_{1\,1\,(x)} = \frac{W\sin\left(\dfrac{\pi\ P}{S}\right)}{\sum\limits_{i-1}^{\bullet}\sin\left[\dfrac{2\pi\ P}{S}\left\{(i-1)+\dfrac{1}{2}\right\}\right]}$$

$$N_{2\,1\,(x)} = \frac{W\sin\left(\dfrac{2\pi\ P}{S}\times\dfrac{3}{2}\right)}{\sum\limits_{i-1}^{\bullet}\sin\left[\dfrac{2\pi\ P}{S}\left\{(i-1)+\dfrac{1}{2}\right\}\right]}$$

Formula (4)

$$N_{k\,1\,(x)} = \frac{W\sin\left[2\pi\ P/S\left\{(k-1)+\dfrac{1}{2}\right\}\right]}{\sum\limits_{i-1}^{\bullet}\sin\left[\dfrac{2\pi\ P}{S}\left\{(i-1)+\dfrac{1}{2}\right\}\right]}$$

$\bullet$

$\bullet$

$\bullet$

$$N_{(\bullet)\cdot 1\,(x)} = \frac{W\sin\left[2\pi\ \dfrac{P}{S}\left\{(S-1)+\dfrac{1}{2}\right\}\right]}{\sum\limits_{i-1}^{\bullet}\sin\left[\dfrac{2\pi\ P}{S}\left\{(i-1)+\dfrac{1}{2}\right\}\right]}$$

Subscripts show the number of turns of each of winding groups x.

Next, N_{k2} in the formula (3) is represented by the formual (5) by resolving 2nd-phase winding group y at cosine side at every slot 30.

2nd phase winding group (COS) side

$$N_{12} = \frac{W\sin(\frac{\pi\ P}{S} + \frac{\pi}{2})}{\overset{\bullet}{\underset{i-1}{\Sigma}}\sin[\frac{2\pi\ P}{S}(i-1) + \frac{1}{2} + \frac{\pi}{2}]}$$

$$N_{22} = \frac{W\sin(\frac{2\pi\ P}{S} \times \frac{3}{2} + \frac{\pi}{2})}{\overset{\bullet}{\underset{i-1}{\Sigma}}\sin[\frac{2\pi\ P}{S}\{(i-1) + \frac{1}{2}\} + \frac{\pi}{2}]}$$

$$N_{k2} = \frac{W\sin[\frac{2\pi\ P}{S}\{(k-1) + \frac{1}{2}\} + \frac{\pi}{2}]}{\overset{\bullet}{\underset{i-1}{\Sigma}}\sin[\frac{2\pi\ P}{S}\{(i-1) + \frac{1}{2}\} + \frac{\pi}{2}]}$$

$$N_{(s)\cdot 1} = \frac{W\sin[\frac{2\pi\ P}{S}\{(S-1) + \frac{1}{2}\} + \frac{\pi}{2}]}{\overset{\bullet}{\underset{i-1}{\Sigma}}\sin[\frac{2\pi\ P}{S}\{(i-1) + \frac{1}{2}\} + \frac{\pi}{2}]}$$

Formula (5)

Subscripts show the number of turns of the winding of each of wiring group x. That is, N_{k2} in the formula (3) is the number of the winding in the slot 30.

As shown in Fig. 17, the windings N_{11}, N_{21}, N_{31}, and N_{41} in the winding group x shown by the formulas (4) and (5) are arranged at the inner sides B and the outer sides C in the slots 30, respectively.

The winding groups x in the slots 30 at the sine side (represented by the formula (4)) and the cosine side (represented by the formula (5)) in the above-mentioned one-phase winding group y are arranged as shown in Table 1, respectively. In Table 1, symbols S1 to S4 correspond to the terminals S1 to S4 in Fig. 4, respectively. C in the slots 30, respectively.

The winding groups x in the slots 30 at the sine side (represented by the formula (4)) and the cosine side (represented by the formula (5)) in the above-mentioned one-phase winding group y are arranged as shown in Table 1, respectively. In Table 1, symbols S1 to S4 correspond to the terminals S1 to S4 in Fig. 4, respectively.

Table 1

| | S1(start) | S2(start) | * |
| | ↓ | ↓ | ↓ |
Slot	sine side	cosine side	sine side
1	(1) inner side B $(N_{1 \cdot 1})$	(9) outer side C $(N_{1 \cdot 2})$	
2		(10) inner side B $(N_{2 \cdot 2})$	(5) outer side C $(N_{2 \cdot 1})$
3	(2) inner side B $(N_{3 \cdot 1})$	(11) outer side C $(N_{3 \cdot 2})$	
4		(12) outer side B $(N_{4 \cdot 2})$	(26) inner side C $(N_{4 \cdot 1})$
5	(3) inner side B $(N_{5 \cdot 1})$	(13) outer side C $(N_{5 \cdot 2})$	
6		(14) inner side B $(N_{6 \cdot 2})$	(27) outer side C $(N_{6 \cdot 1})$
7	(4) inner side B $(N_{7 \cdot 1})$	(15) outer side C $(N_{7 \cdot 2})$	
8		(16) inner side B $(N_{8 \cdot 2})$	(28) outer side C $(N_{8 \cdot 1})$
9	(5) inner side B	(17) outer side C	

		$(N_{9.1})$	$(N_{9.2})$	
10		(18) inner side B	(29) outer side C	
		$(N_{10.2})$	$(N_{10.1})$	
11	(6) inner side B	(19) outer side C		
	$(N_{11.1})$	$(N_{11.2})$		
12		(20) inner side B	(30) outer side C	
		$(N_{12.2})$	$(N_{12.1})$	
13	(7) inner side B	(21) outer side C		
	$(N_{13.1})$	$(N_{13.2})$		
14		(22) inner side B	(31) outer side C	
		$(N_{14.2})$	$(N_{14.1})$	
15	(8) inner side B	(23) outer side C		
	$(N_{15.1})$	$(N_{15.2})$		
16		(24) inner side B	(32) outer side C	
		$(N_{16.2})$	$(N_{16.1})$	
	↓	↓	↓	
Slot 30 *		S4 (END)	S3 (END)	

Symbol * represents a short condition.

S1 to S4 represent terminals.

(1) ~ (32) show a winding order.

Therefore, as shown Table 1, winding groups x are arranged alternately at the inner sides B and the outer sides C of the slots 30, as shown in Fig. 17.

Since the sinusoidally distributed winding method for a detector winding according to the prsent invention is carried out as described above, it is possible to provide winding at every one-slot intervals. A winding has not ever been able to be performed using an automatic winding machine. But the present invention enables an automatic winding, thus leading to large cost reduction.

Further, since the number of winding turns at each winding portion can be easily calculated using the formula (1), the sinusoidally distributed magnetic flux decompositon distribution can be obtained accurately, whereby the accuracy of a rotation analog signal which is obtained by a resolver or the like can be improved largely.

Further, it is possible to uniform a winding position of a sin and cosin side in said slots whereby a stable precise detector is obtained.

Still other variations and modifications are possible within the scope of the present invention which is limited solely by the appended claims.

Claims

1. In a sinusoidally distributed winding method suitable for a detector winding wherein n-phase winding groups (Z) are wound on a ring core (20) which has a given number (S) of tooth portions (31) and slots

(30) on its inner diameter side so that one phase winding groups (y) produces a 2P polar and sinusoidally distributed magnetic flux distribution of said n-phase winding groups (Z), the improvement comprising the steps of connecting serially winding groups (X) on said ring core (20) of the number (S) corresponding to that of said slots (30) to construct said one-phase winding groups (y), said winding groups being wound at one-slot pitch intervals, and using a plurality of said one-phase winding groups (y) to construct said n-phase winding groups (Z), whereby a 2P polar and n-phase sinusoidally distributed magnetic flux is provided.

2. A sinusoidally distributed winding method suitable for a detector winding according to claim 1, wherein said number of winding turns in each of the slots (30) of said one phase shunt winding (y) is set by the following formula:

$$N_{k\,1} = \frac{W\sin[2\pi\,P/S\{(k-1)+\frac{1}{2}\}]}{\sum_{i-1} \sin[2\pi\,P/S\{(i-1)+\frac{1}{2}\}]}$$

$$N_{k\,2} = \frac{W\sin[2\pi\,P/S\{(k-1)+\frac{1}{2}\}+\frac{2\pi}{n}]}{\sum_{i-1} \sin[2\pi\,P/S\{(i-1)+\frac{1}{2}\}+\frac{2\pi}{n}]}$$

$$N_{k\,(n)} = \frac{W\sin[2\pi\,P/S\{(k-1)+\frac{1}{2}\}+\frac{2\pi\,(n-1)}{n}]}{\sum_{i-1} \sin[2\pi\,P/S\{(i-1)+\frac{1}{2}\}+\frac{2\pi\,(n-1)}{n}]}$$

where

$N_{k(n)}$ is the number of turns of the winding portion at the k-th, or a given integer, slot satisfying i = 1.. .. s in the (n)-th winding group in the n-phase;

W is the total number of turns (the sum of windings wound at each slot in one phase when i = 1 to s); and

S is the number of slots.

3. A sinusoidally distributed wave winding method suitable for a detector winding according to claim 1, wherein said n-phase winding groups (Z) includes a resolver constructed using a sine phase and a cosine phase, sais sine and cosine phases being arranged alternately to said inner side (B) and an outer side (C) of said slot (30).

4. A sinusoidally distributed sinding method suitable for a detector winding according to anyone of claim 1, wherein said n-phase winding groups (Z) are wound by way of a guide pin (41) arranged at an outer position of each slot (30) of said ring core (20).

5. A sinusoidally distributed winding method suitable for a detector winding according to anyone of claim 1, wherein an insulating member (43) having a guide pin (30) is arranged at an outer position of each slot (30) of said ring core (20) and wherein said n-phase winding groups (Z) are wound by way of said guide pin (41).

6. A winding method, substantially as herein described with reference to any of figures 6 to 17 of the accompanying drawings.
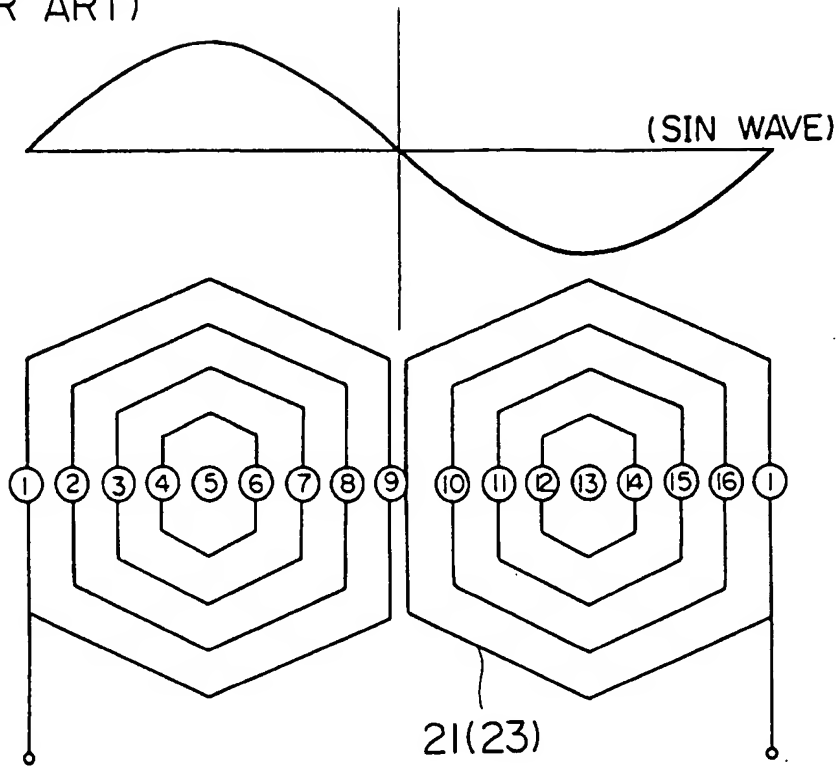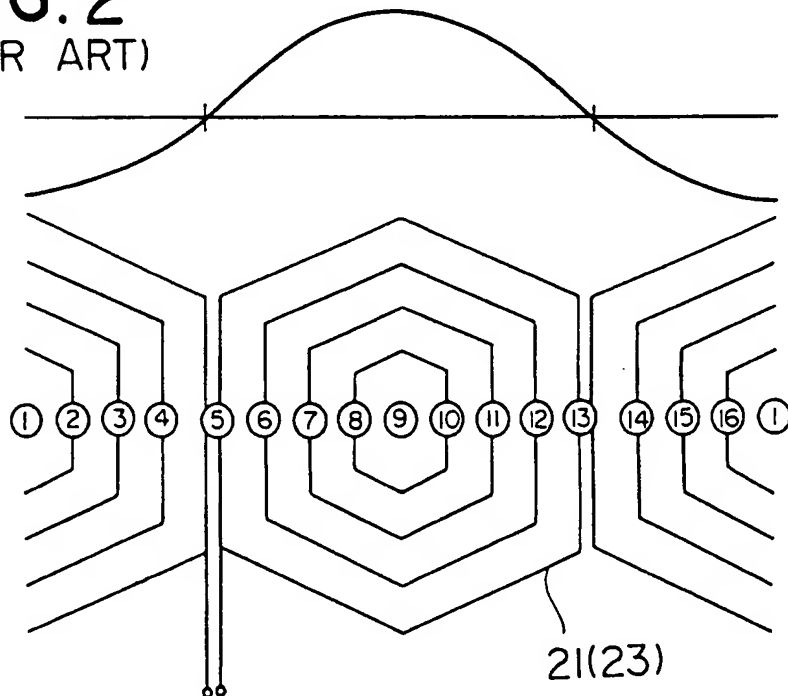
FIG. 1
(PRIOR ART)

(SIN WAVE)

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬ ⑭ ⑮ ⑯ ①

21(23)

FIG. 2
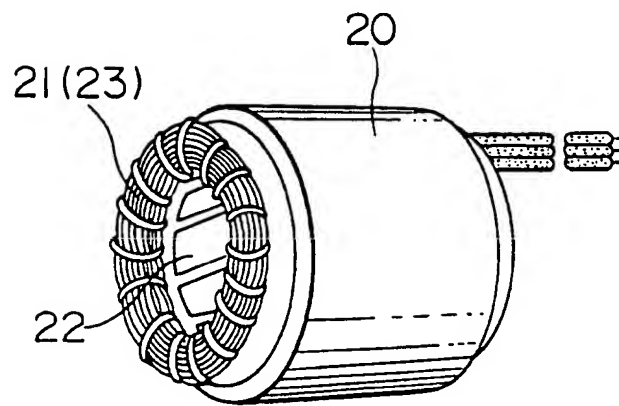(PRIOR ART)

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬ ⑭ ⑮ ⑯ ①

21(23)

FIG. 3
(PRIOR ART)

FIG. 4
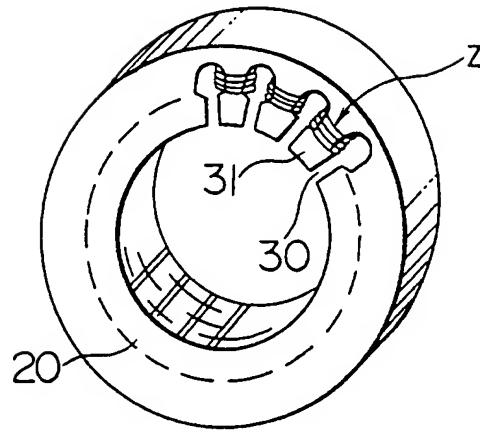## (PRIOR ART)

FIG. 5
(PRIOR ART)

ACTUAL MAGNETOMOTIVE FORCE (mmf)
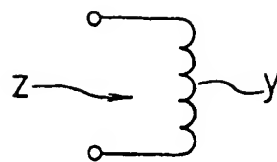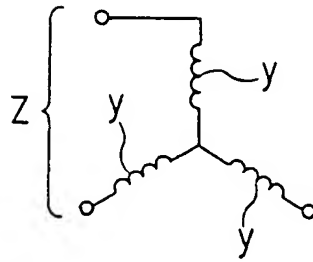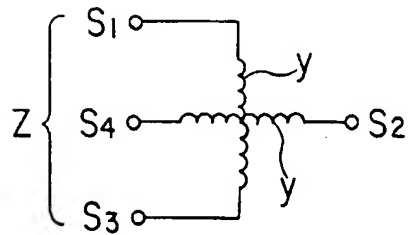
SIN WAVE
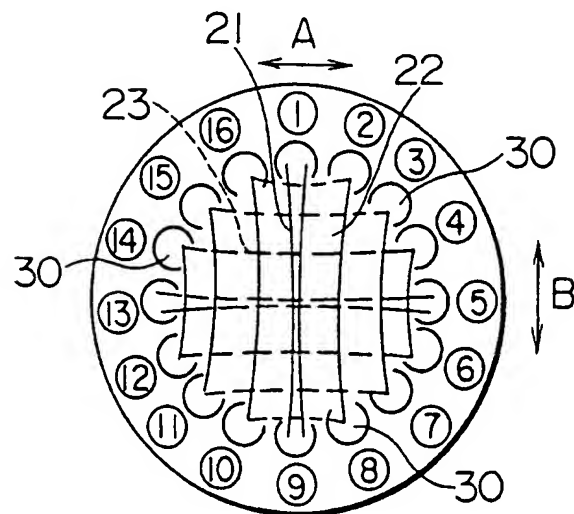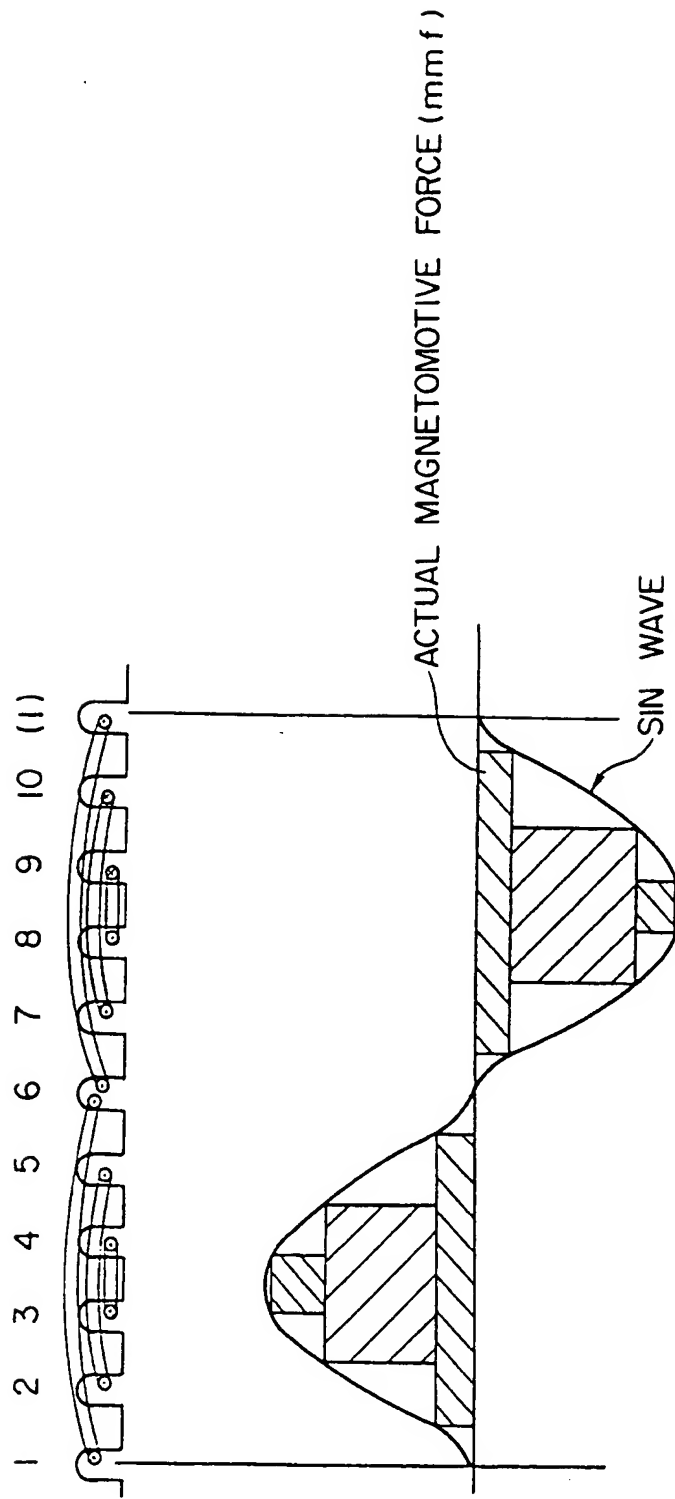
FIG. 6
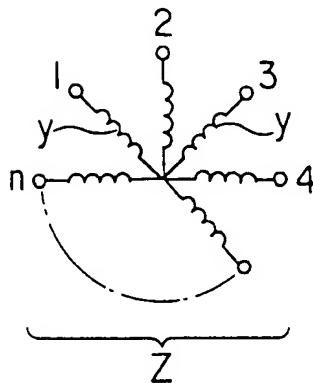

FIG. 7

(1-PHASE WINDINGS)

FIG. 8

SYNCRO = 3-PHAS WINDINGS

FIG. 9

RESOLVER = 2-PHASE
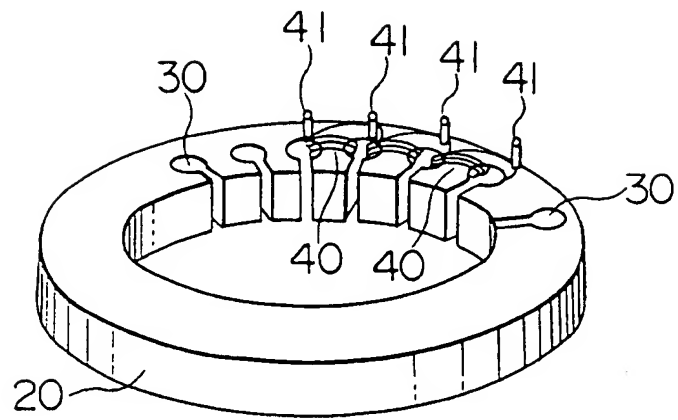WINDINGS OR 4-PHASE
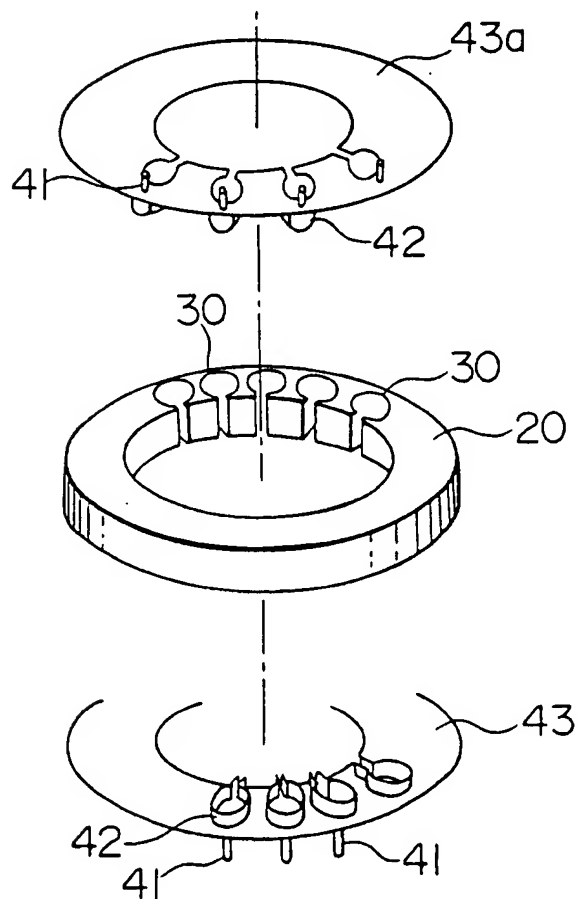
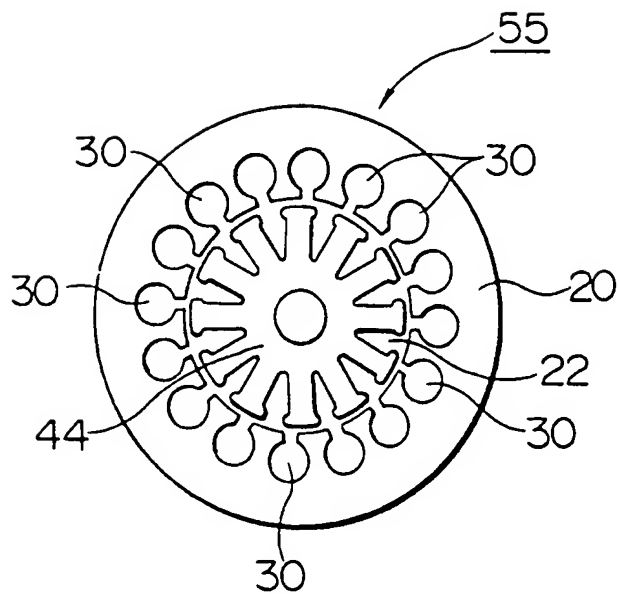# FIG. 10

N-PHASE WINDINGS

FIG. 11

FIG. 12

FIG. 13

FIG. 14

FIG. 15

FIG. 16

$N_{11} \sim N_{(S-1),1}$
(SIN SIDE = RESOLVER
1st PHASE FORM)

POLARITY AND AMPLITUDE

2.5 SLOT
1.5 SLOT
0.5 SLOT

$x \cdots y$

$y \times n = Z$
RESLVER : n=2

$N_{12} \sim N_{(S-1),2}$
(COS SIDE = RESOLVER
2nd PHASE FORM)

POLARITY AND AMPLITUDE
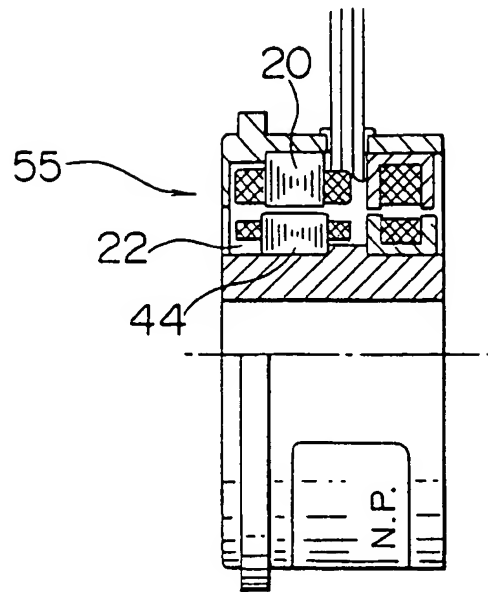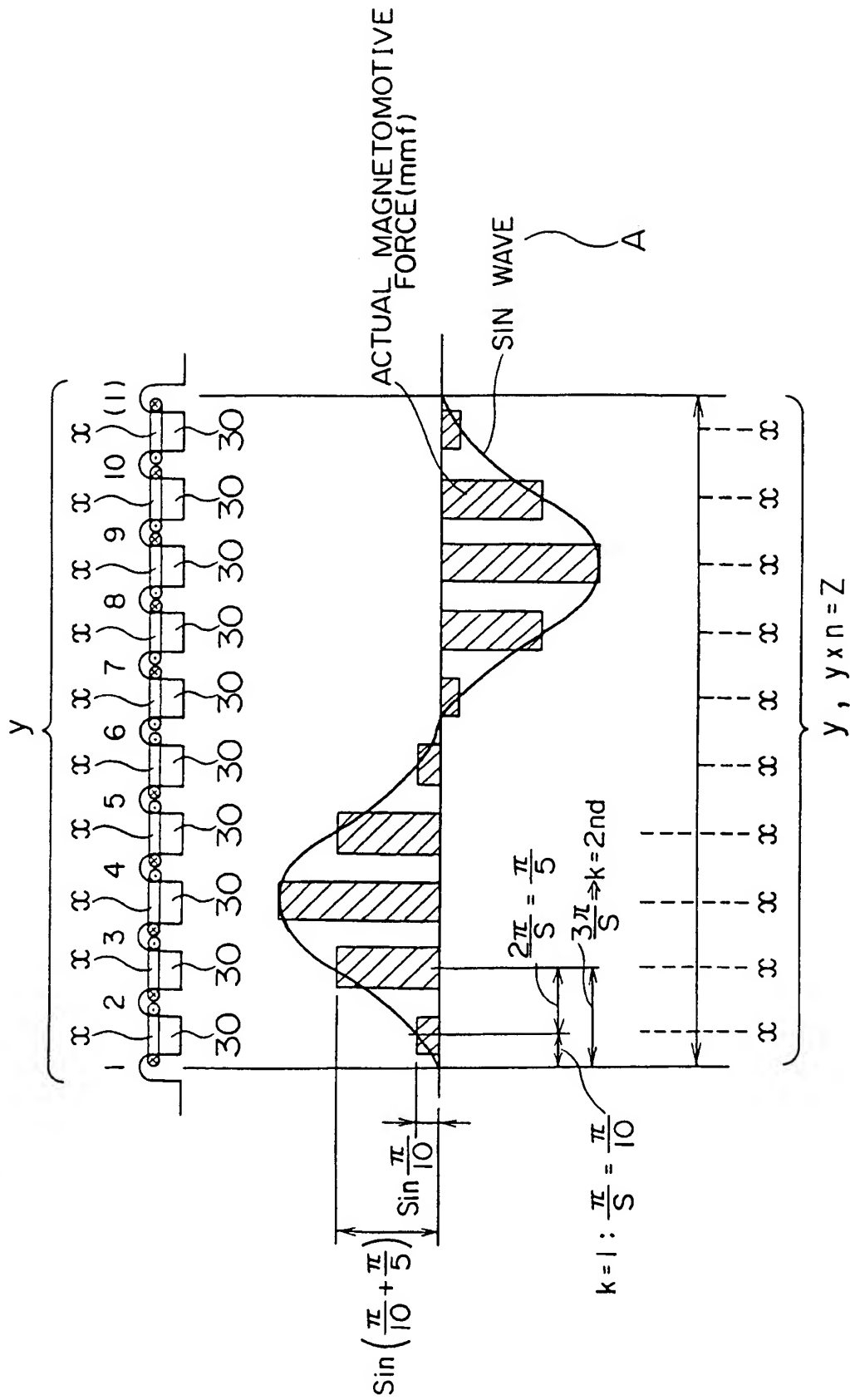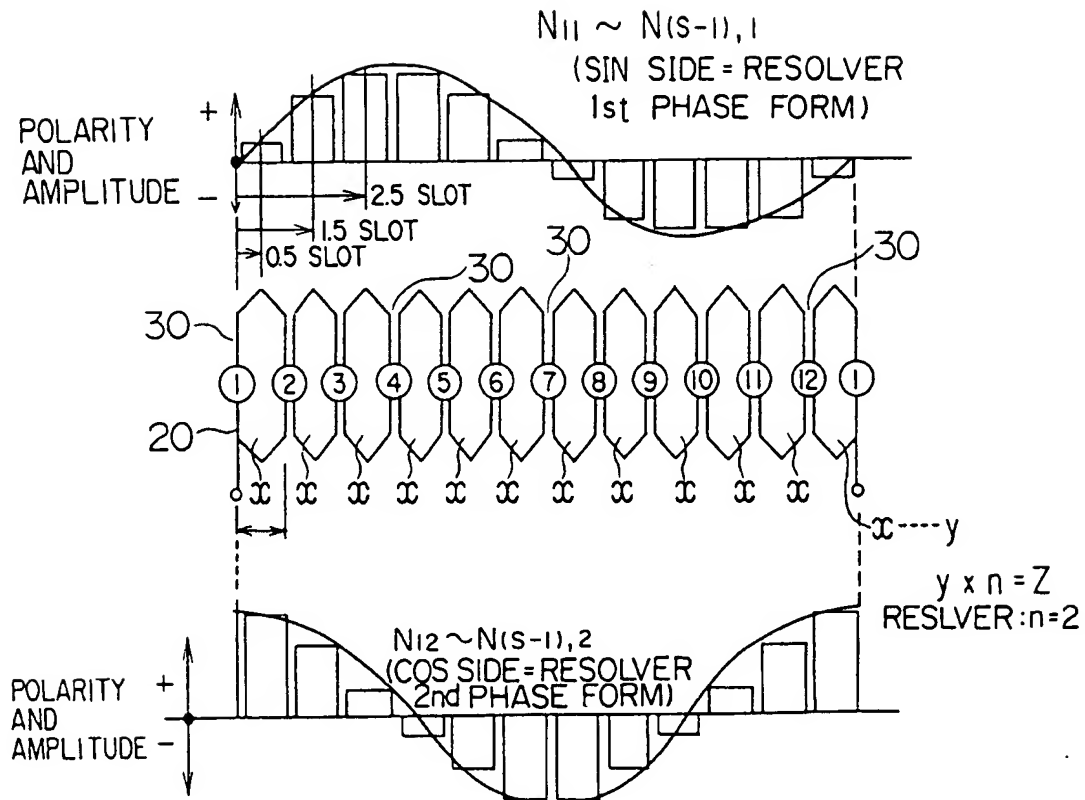
FIG. 17

(WINDING ARRANGEMENT)

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	EP-A-0 449 298 (MITSUBISHI) * column 4, line 23 - column 6, line 49; claim 1; figure 3 * ---	1,2	H02K3/28
A	GB-A-966 576 (NATIONAL RESEARCH DEVELOPMENT CORPORATION) * page 3, line 13 - page 4, line 87; figures 2,3,5 * ---	1	
A	US-A-4 492 890 (LITTON INDUSTRIAL PRODUCTS) * column 6, line 61 - column 9, line 16; figures 1-4 * -----	1	

TECHNICAL FIELDS
SEARCHED   (Int.Cl.5)

H02K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 January 1994	Zoukas, E

EPO FORM 1503 03.82 (P04C01)